PRATIK SHAH Ph.D.

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biography

My research creates novel intersections between engineering, medical imaging, machine learning and microbiology to develop low-cost diagnostics and therapeutics as scalable medical technologies. My graduate and postdoctoral research led to the discovery of a vaccine element to prevent pneumococcal (*Streptococcus pneumoniae*) diseases, identification of new pathways, technologies, metabolites as antimicrobials to target gastrointestinal infections, and a non profit to deploy a low-cost water quality test for the developing world. Past recognitions include, American Society for Microbiology's Raymond W. Sarber national award, Harvard Medical School and Massachusetts General Hospitals ECOR Fund for Medical Discovery postdoctoral fellowship, coverage by leading national and international news media outlets and a TED talk. Ongoing research areas at MIT; 1) artificial intelligence methods for detection of fluorescent cancer biomarkers using standard photographs vs. expensive medical images; 2) unorthodox and unsupervised artificial intelligence algorithms to design optimal and faster clinical trials to reduce adverse effects on patients; 3) low cost and open source imaging devices, paper diagnostics, algorithms and mobile phones to improve public health. Clinical studies with my medical technologies have revealed "Missing sick" patients who otherwise remain undiagnosed in conventional healthcare settings. I have been an invited as discussion leader at Gordon Research Seminars, speaker at Cold Spring Harbor Laboratories, Gordon Research Conferences and IEEE bioengineering conferences and a peer reviewer for leading scientific publications and funding agencies. I have a BS, MS and a PhD in Microbiology and completed fellowship training at The Broad Institute of MIT and Harvard, Massachusetts General Hospital and Harvard Medical School.

education, training and experience

2015-17 **Research Scientist and Principal Investigator**
Department of Media, Arts and Sciences
MIT Media Lab

2010-14 **ECOR Fund for Medical Discovery Postdoctoral Fellow**
Molecular Biology, Infectious Diseases & Microbiology
Broad Institute / Harvard Medical School and Massachusetts General Hospital

2004-10 **Ph.D.** Microbiology
Dissertation: Role of Polyamine Biosynthesis and Transport Pathways in *Streptococcus pneumoniae* Physiology, Pathogenesis and Vaccine Design
University of MS. Medical Center / University of Alabama at Birmingham

2001–03 **M.S.** Microbiology
Thesis: Discovery and Characterization of a Novel Enzyme for Digestion of Pectin
University of Mumbai

1998-01 **B.S.** Microbiology
University of Mumbai

peer reviewed conference and journal publications

Molecular Microbiology | Infection and Immunity | Microbiology | FEMS Microbiology | Microbial Pathogenesis | The American Journal of Medical Sciences | Experimental Biology and Medicine | SIGGRAPH | CVPR | Journal of Translational Engineering in Health and Medicine | BMC Oral | British Medical Journal | IEEE International Conference on Bioinformatics and Bioengineering | National Institutes of Health | IEEE Engineering in Medicine and Biology Society | Proteomics | BMC Genomics | American Chemical Society Sensors |

Microbiology and Infectious diseases Bioengineering and Machine learning OMICS technologies

2017 Technology-enabled non-invasive examinations augment primary care
Pratik Shah*, Yauney G, Gupta O, Patalano V, Mohit M, Merchant R, Subramanian SV
The British Medical Journal Open, submitted August 2017, under revision November 2017
*Senior author supervising research

2017 Clinical validation and assessment of a modular fluorescent imaging system and algorithm for rapid detection and quantification of dental plaque
Pratik Shah*, Angelino K, Edlund D, Mohit M, Yauney G
BMC Oral, submitted April 2017, under revision November 2017
*Senior author supervising research

2017 Detection of biomarkers of periodontal disease in human saliva using stabilized, vertical flow immunoassays
Emma Yee, Lathwal S, Shah P†, Sikes H
ACS Sensors, 2017, PMID: 29090909, †Collaboration with MIT Dept. Chemical Engineering, Cambridge, MA

2017 Automated segmentation of gingival diseases from oral images
Aman Rana, Yauney G, Wong L, Muftu A, Shah P*
IEEE-NIH 2017 Special Topics Conference on Healthcare Innovations and Point-of-Care Technologies
*Senior author supervising research

2017 Convolutional neural network for combined classification of fluorescent biomarkers and expert annotations using white light images
Yanuey G, Angelino K, Edlund D, Shah P*♯
17th annual IEEE International Conference on BioInformatics and BioEngineering
*Senior author supervising research, ♯Selected for oral presentation

2017 Near-infrared transillumination guides administration of dental 2D radiography and CBCT imaging
Keith Angelino, Edlund D, Bhatia G, Wu S, Shah P*♯
17th annual IEEE International Conference on BioInformatics and BioEngineering
*Senior author supervising research, ♯Selected for oral presentation

2017 Near-infrared imaging for detecting caries and structural deformities in teeth
Keith Angelino, Edlund D and Shah P*
Journal of Translational Engineering in Health and Medicine, PMID: 5418067
*Senior author supervising research

2016 Design and preliminary evaluation of a wearable device for mass screening of sleep apnea
Rohan Puri, Athanasios A, Gill N, Sathya S, Rathod G, Wahi A, Satat G, Majmudar M, Shah P*
Conf Proc IEEE Eng Med Biol Soc, PMID: 28268691
*Senior author supervising research

2016 Capturing the human body: from VR, consumer, to health applications
Hao Li, Lei W, Swedish T, Shah P, Raskar R
ACM SIGGRAPH Course

2016 Clinical imaging of the human body: for health, visualization and predictive analytics
Ramesh Raskar, Shah P, Swedish T, Mohit M
Computer Vision Pattern Recognition Tutorial

2014 New signaling pathways and metabolites for host: pathogen communication during gastrointestinal infections
Pratik Shah and Hung D
Proceedings of 5th American Society of Microbiology Conference on Cell-Cell Communication in Bacteria

2011 Polyamine biosynthesis and transport mechanisms are crucial for fitness and pathogenesis of *Streptococcus pneumoniae*
Pratik Shah, Nanduri B, Swiatlo E, Ma Y, Pendarvis K
Microbiology, PMID: 20966092

2011 Misidentification of *Candida parapsilosis* as *C. famata* in a clinical case of vertebral osteomyelitis
Mary Jane Burton, Shah P, Swiatlo E
The American Journal of the Medical Sciences, PMID: 20944497

2010 Identification of novel non-coding small RNAs from *Streptococcus pneumoniae* TIGR4 using high-resolution genome tiling arrays
Pratik Shah, Kumar R, Swiatlo E, Burgess SC, Lawrence ML, Nanduri B
BMC Genomics, PMID: 20525227

2010 Regulation of *Vibrio cholerae* virulence gene expression and pathogenesis in microaerophilic growth conditions
Pratik Shah, Oh D, Hung D
Proceedings of Cold Spring Harbor Laboratory, Molecular Genetics of Bacteria and Phage Meeting

2009 Differential gene expression in *Streptococcus pneumoniae* in response to various iron sources
Radha Gupta, Shah P, Swiatlo E
Microbial Pathogenesis, PMID: 19464356

2009 Mucosal immunization with polyamine transport protein D (PotD) protects mice against nasopharyngeal colonization with *Streptococcus pneumoniae*
Pratik Shah, Briles DE, Ki n g J, Hale Y, Swiatlo E
Experimental Biology and Medicine, PMID: 19176871

2009 Role of polyamine transport in *Streptococcus pneumoniae* response to physiological stress and murine septicemia
Pratik Shah, Romero DG, Swiatlo E
Microbial Pathogenesis, PMID: 18572376

2008 A multifaceted role for polyamines in bacterial pathogens
Pratik Shah, Swiatlo E
Molecular Microbiology, PMID: 18405343

2008 Quantitative analysis of *Streptococcus pneumoniae* TIGR4 response to in vitro iron restriction by 2-D LC ESI MS/MS
Bindu Nanduri, Shah P, Ramkumar M, Allen EB, Swiatlo E, Burgess SC, Lawrence ML
Proeomics, PMID: 18491321

2008 Community-acquired methicillin-resistant *Staphylococcus aureus* as a cause of Fournier's Gangrene
Mary Jane Burton, Shah P, Swiatlo E
The American Journal of the Medical Sciences, PMID: 18414076

2006 Immunization with polyamine transport protein PotD protects mice against systemic infection with *Streptococcus pneumoniae*
Pratik Shah, Swiatlo E
Infection and Immunity, PMID: 16988268

2006 Cellular location of polyamine transport protein PotD in *Streptococcus pneumoniae*
Pratik Shah, Marquart M, Quin LR, Swiatlo E
FEMS Microbiology Letters, PMID: 1690772

select research presentations

Total Presentations [40] - Invited [16] • Poster [10]

American Society for Microbiology | National Institutes of Health | Gordon Research Conference | Cold Spring Harbor Laboratories | Molecular Genetics of Bacteria and Phage Conference | MIT Media Lab | Gordon Research Seminar | Cell-to-Cell Communication in Bacteria | MIT Microsystems Technology Laboratories | Google | TED | New England Regional Center of Excellence for Biodefense and Emerging Infectious Diseases | University of Alabama at Birmingham | Rocky Mountain Laboratories, NIH | Welingkar Institute, Mumbai | Rice University | Pontifical Catholic University of Peru | Centro de Investigación en Matemática | Annual International Conference of the IEEE Engineering in Medicine and Biology Society | Centro de Investigaciones en Optica | View | Medical informatics | MIT, Industrial Liaison Program |

Microbiology and Infectious diseases Bioengineering and Machine learning OMICS technologies

research presentations-podium

2017	Artificial Intelligence for Medical Images *Massachusetts Institute of Technology ILP Health Sensing and Imaging*	Cambridge, MA
2017	Innovating for billions with computational sensors *Medical Informatics World Conference*	Boston, MA
2016	Visualization of diseases biomarkers using augmented reality interfaces *View Conference*	Turin, Italy
2016	Next generation of healthcare technologies *Centro de Investigación en Matemática, MX*	Leon, Mex
2016	Machine learning + adaptive optics for medical imaging *Pontifical Catholic University of Peru*	Lima, Peru
2016	Next generation of biomedical technologies *Centro de Investigaciones en Optica, MX*	Guanajuato, Mex
2016	Next generation of health technology solutions *Rice University*	Houston, TX
2015	Innovating for billions: digital technologies for healthcare screening *Welingkar Institute*	Mumbai, India
2014	Discussion leader-Molecular systems and community responses *Gordon Research Seminar*	Hadley, MA
2014	New signals, pathways and mechanisms for two component systems and host-pathogen interactions for enteric infections. *Molecular Genetics of Bacteria and Phage Conference*	Madison, WI
2014	Omics, nano and high throughput technologies and new health tech innovations *Rethinking Diagnostics Conference, MIT Media Lab*	Cambridge, MA
2013	Emerging technologies for new innovations in diagnostics, therapeutics and prophylaxis of gastrointestinal infections *MIT Microsystems Technology Laboratories*	Cambridge, MA
2010	Regulation of *Vibrio cholerae* virulence gene expression and pathogenesis in microaerophilic growth conditions *Cold Spring Harbor Conferences*	Cold Spring Harbor, NY
2010	Oxygen availability and cholera: new link for an old disease *Frontiers in Mucosal Immunology Conference*	Boston, MA
2009	Polyamines and the pneumococcus: partners in crime *Laboratory of Zoonotic Pathogens at Rocky Mountain Laboratories, National Institutes of Health*	Hamilton, MT

2009 Polyamines and the pneumococcus: partners in crime — Birmingham, AL
18th Annual Pneumococcal Research Symposium, University of AL at Birmingham

select research presentations-poster

2015 Modalities for biological tagging and tracking of infected humans
2nd DARPA Biology is Technology Conference, New York, NY

2014 Tyrosine phosphorylation of bacterial response regulator and cholera disease
114th American Society for Microbiology General Meeting, San Antonio, TX

2014 Discovery of novel phosphorylation based molecular rheostat regulating virulence in *Vibrio cholerae*
Microbial Stress Response Gordon Research Seminar, South Hadley, MA

2012 A phosphorylation dependent molecular "rheostat" regulates virulence expression in *Vibrio cholerae* during infection versus metabolism in the environment
Microbial Toxins and Pathogenicity Gordon Research Conference, Waterville valley, NH

2011 Regulation of *Vibrio cholerae* virulence gene expression and pathogenesis in response to novel host signals
7th Harvard Medical School New England Regional Center Excellence Annual Retreat, Newport, RI

2009 Polyamine biosynthesis and transport mechanisms are crucial for fitness and pathogenesis of *Streptococcus pneumoniae*
109th American Society for Microbiology General Meeting, Philadelphia, PA

2008 Polyamines and pneumococcus: partners in crime
3rd National Institutes of Health Annual Retreat, Hamilton, MT

2008 Mucosal immunization with Polyamine Transport Protein D (PotD) protects mice against nasopharyngeal colonization with *Streptococcus pneumoniae*
108th American Society for Microbiology General Meeting, Boston, MA

2007 Role of polyamine transport in *Streptococcus pneumoniae* response to physiological stress and murine septicemia
107th American Society for Microbiology General Meeting, Toronto, Canada

2006 Immunization with Polyamine Transport Protein PotD protects mice against systemic infection with *Streptococcus pneumoniae*
106th American Society for Microbiology General Meeting, Orlando, FL

select public presentations

2017 Unorthodox AI for biomarker imaging — Arusha, Tanzania
TED Conference (TEDGlobal)

2016 Making healthcare accessible, printable and deployable — Goa, India
INK Talks

2014 Bugs, drugs and guts — Boston, MA
TEDx BeaconStreet

2014 New strategies for developing next-generation of anti-microbial therapies — Cambridge, MA
Google Solve for X Event, Google Inc.

mentorship (no. of coauthored papers)

2017-present	Aman Rana Senior Research Support Associate, MIT Media Lab (3)
2016-present	Greg Yauney Technical Associate, MIT Media Lab (8)
2015-present	Keith Angelino Technical Associate, MIT Media Lab (6)
2015-present	Tristan Swedish Graduate Student Co-mentored with Dr. Ramesh Raskar, MIT Media Lab (1)
2015-present	Guy Satat Graduate Student Co-mentored with Dr. Ramesh Raskar, MIT Media Lab (1)
2015-present	Otkrist Gupta Graduate Student Co-mentored with Dr. Ramesh Raskar, MIT Media Lab (2)
2016-17	Gaurav Bhatia Senior Research Support Associate, MIT Media Lab (1), currently Electrical Engineer at Harbor Designs
2016-17	Sharon Wu UROP and UAP Course 6-7, Class of 2017, MIT (1), currently Research Technician at Massachusetts General Hospital
2015-16	Mrinal Mohit Graduate Student Co-mentored with Dr. Ramesh Raskar, MIT Media Lab (2), currently Software Engineer Facebook
2013	Tian Tian Zhu-White, Massachusetts General Hospital, currently Research Technician at Massachusetts General Hospital
2011	Daniel Oh, Massachusetts General Hospital (1), currently Medical Student Harvard Medical School and HHMI

select awards

2017	TED Fellowship- International community of visionaries who collaborate across disciplines to create positive change around the world
2016	INK Fellowship- International fellowship for contributions to technology advancements for global impact
2014	Conference Travel Award- American Society for Microbiology, San Antonio, TX
2014	Conference Grant- Gordon Research Seminar, Hadley, MA- Honorarium to organize conference
2010	Postdoc Fellowship Award- ECOR Fund for Medical Discovery Fellowship-Independent grant
2010	Fellowship Travel Award- National Postdoctoral Association Meeting, Philadelphia, PA
2009	Raymond W. Sarber Award- American Society for Microbiology (National Award)
2009	Best Paper Award- American Society for Microbiology, Philadelphia, PA
2009	Deans Ph.D. Dissertation Research (Charles C Randall) Award
2008	Best Presentation Award-School of Graduate Studies in Health Sciences Research Day
2008	NIH National Graduate Student Research Conference Award, Bethesda, MD
2008	American Society for Microbiology Kadner Institutes Workshop Award, Boulder, CO
2008	Press Release: American Society for Microbiology's General Meeting Boston, MA- Discovery of a new vaccine candidate against bacterial pneumonia
2006	Best Paper Award- American Society for Microbiology, Orlando, FL

select media coverage on research *(links to world wide web resources)*

2017	Thrive Global article on TED talk
2017	AFP article on TED talk
2017	TED talk highlighted by TED blog
2016	Pontifical Catholic University of Peru- MIT International Science and Technology Initiative
2016	MIT News- Student mentored for MIT International Science and Technology Initiative
2016	MEDTECH Boston- Article on Engineering Health course at MIT
2015	Daily mail UK – Article on work in Emerging Worlds special interest group at MIT
2015	Hindustan Times – Article on work in Emerging Worlds special interest group at MIT

2014 TEDx Conference –TedX innovation spotlight article

2014 Google Solve for X - Google Inc. describes research on its moonshots webpage

2014 Medstro: New England Journal of Medicine - News article on TEDx presentation

2009 Meet the Scientist - Podcast of interview by American Society for Microbiology

peer review, judging and panels

Nature Communications, Infection and Immunity, *Molecular Microbiology, IEEE, Amino Acids*, *PLOSone, Virulence, FEMS*

National Institutes of Health, Grants reviews board and refereed panel on health and medical research fund application

42nd International conference on infrared, millimeter and terahertz waves, organizer and technical reviewer

TEDMED Inc- Advisory committee for speaker selection

Reviewer, judge and mentor for the Life Sciences Track in MIT $100K

Reviewer, judge and mentor for the National Collegiate Inventors and Innovators Alliance Health Tech Accelerator

teaching *(links to world wide web resources)*

2015 Instructor, Engineering health- Six credit course offered by MIT Media Arts and Science to Design and build novel health diagnostics and sensors
MIT Media Lab

2013 Instructor, Rethinking diagnostics- Six credit course offered by MIT Media Arts and Science for developing the infectious disease modality of "Tricorder", a portable handheld device that diagnoses clinical correlates of bacterial infections
MIT Media Lab

2013 MIT Teaching Certificate Program Included assessment methods, course design with articulation of goals and learning outcomes, interactive teaching, active learning and enhancing learning with technologies
MIT

description of research projects

2015-17 MASSACHUSETS INSTITUTE OF TECHNOLOGY MEDIA LAB, Cambridge, MA

Imaging technologies for disease biomarkers, artificial intelligence for drug development and low-cost global health solutions

Research Scientist and Principal Investigator

New paradigms of unorthodox machine learning and artificial intelligence solutions for discovery of diagnostics, prognoses and therapeutics for cancer, infectious diseases and oral disorders: Detection of biomarkers for cancer and other diseases from standard photographs vs. expensive medical images

Artificial intelligence architectures to design clinical trials, discover new antibiotic resistance mechanisms and predict epidemics: Novel inputs and deep learning architectures to accelerate drug discovery, safer and faster clinical trials, combat and predict infectious disease outbreaks

Machine learning platforms for primary health screening: Open source hardware and software modules powered by mobile phones, computer vision, paper diagnostics and machine learning to provide low-cost healthcare screenings

2010-15 MASS. GENERAL HOSPITAL,HARVARD MEDICAL SCHOOL,BROAD INSTITUTE OF MIT & Harvard, Cambridge, MA

Antimicrobial therapeutic targets using nanotechnology, Omics and molecular biology

Research Fellow, Dept. of Molecular Biology and Infectious Disease Initiative at Broad Institute

Novel technologies to elucidate host-pathogen interactions. Developed *in vivo* NanoString assays for sample preparation and processing for identification of compounds, lipids and bacterial genes responsible for diarrheal diseases from infected animals. Approach has wide applications for development of diagnostics, therapeutics and vaccines against infectious diseases

Identification and characterization of pathways that regulate toxin production in enteric pathogens. Discovered new pathways for bacterial toxin activation in response to host metabolic changes during diarrhea

Discovery and characterization of a novel tyrosine kinase that activates cholera toxin production. Found that bacterial tyrosine kinases serve as regulators of cholera pathogenesis

2004-09 UNIVERSITY OF MS MEDICAL CENTER, Jackson, MS / UNIVERSITY OF ALABAMA, Birmingham, AL

Bacterial protein physiology, pathogenesis and vaccine design

Ph.D., Department of Microbiology

Discovered protein vaccine antigen Polyamine Transport Protein D (PotD) protective against *Streptococcus pneumoniae* carriage, pneumonia and invasive infections. Protein antigen-PotD used by governments of Brazil and China for low-cost vaccine

Elucidated the role of host and microbial polyamine metabolism in pneumococcal disease. Discovered polyamine biosynthesis and transport mechanisms are required for pneumococcal infection and are targets for prophylactic and therapeutic interventions

Developed and implemented high-throughput approaches (i.e. genome arrays/proteomics) to elucidate host-pathogen interactions. Identified a new role for iron in increasing risk for pneumococcal disease

leadership and entrepreneurship *(links to world wide web resources)*

2017 MASSSACHUSETS INSTITUTE OF TECHNOLOGY MEDIA LAB, Cambridge, MA

Artificial intelligence for drug discovery and clinical trials to improve public health

- Organized new workshop series with healthcare, pharma and tech companies to develop new paradigm for drug discovery and clinical trials
- Led speaker selection and content creation
- Brainstorming sessions from the workshops to be communicated to *Nature Reviews Drug Discovery* as key guidelines to solve challenges faced by FDA and pharma companies to develop new drugs

2013-14 AQUA-BRIDGE at Harvard Innovation Labs, Allston, MA

Global health initiative using point-of-use filtration and sterilization to deliver safe drinking water
Co-founder

- Developed a non-profit business proposal. Responsible for fund-raising, pitching and promoting Aqua-Bridge in MIT Ideas, MIT
- $100K, Harvard Innovation Lab's Presidents Global, and Deans Design Challenge entrepreneurship competitions
- Deployed water purifying and quality-testing program to detect and decrease disease-causing bacteria in drinking water
- Established support from Idexx and 3M for Aqua-Bridge's operations in Tanzania
- Developed a new bacterial growth media: "Boilert" for rapid water quality testing
- Aqua-Bridge was a resident team of Harvard Innovation Lab's "Venture Incubation Program"